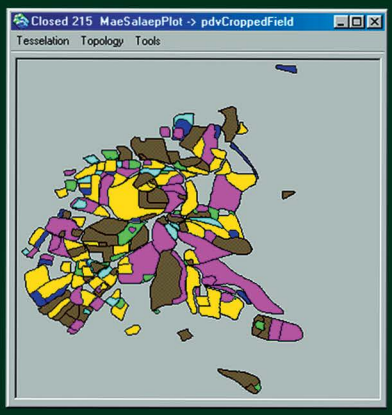
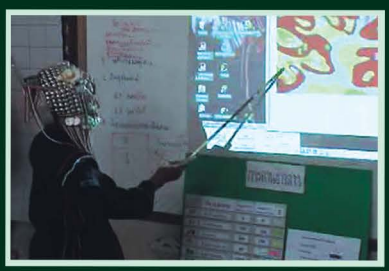
Companion Modeling and Multi-Agent Systems for Integrated Natural Resource Management in Asia





Edited by F. Bousquet, G. Trébuil, and Bill Hardy

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Companion Modeling and Multi-Agent Systems for Integrated Natural Resource Management in Asia

Edited by F. Bousquet, G. Trébuil, and B. Hardy

2005
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International Rice Research Institute

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Suggested citation:
Bousquet F, Trébuil G, Hardy B, editors. 2005. Companion modeling and multi-agent systems for integrated natural resource management in Asia. Los Baños (Philippines): International Rice Research Institute. 360 p.

COVER DESIGN: Juan Lazaro IV
LAYOUT AND DESIGN: Emmanuel Panisales

ISBN 971-22-0208-9

Contents

The Thai traditional learning process in folk culture: implications for the companion modeling approach

I. Patamadit and F. Bousquet

A group of researchers working in the field of renewable resource management tries to apply simulation tools when dealing with these complex systems in order to understand the institutions and norms that drive the interactions among actors, and consequently between actors and their environment. This method can be used in many cultural contexts and leads to generic outputs (collective learning process, good understanding of computer simulation by stakeholders). But the effectiveness of the method seems to be very dependent on the social and cultural context. We decided to do some research on the learning process in Thai traditional culture. It aims at identifying and understanding such villagers' worldview through religious texts, traditional literature and poetry, folk songs and music, ceremonies, and festivals. We try to understand how the Thais interpret their social environment and learn to act accordingly within it. It seems that the companion modeling approach is quite successful in the Thai learning context because the method is based on experience and fun derived from the game process, but the collective discussion aspect that is supposed to emerge from the use of this tool does not really occur, probably because of individualism, a strong cultural structure, a fundamental culture of conflict avoidance, and difficulty in distinguishing reality from virtual scenarios.

The scientific background of companion modeling is presented in the first chapter of this book. The inspirational sources of this approach come on the one hand from the community of researchers working on common property and co-management applied to the management of renewable and natural resources and on the other hand from the community of researchers working on multi-agent simulations, policy simulations, role-games, and participatory modeling. These communities are strongly influenced by results obtained in different cultural contexts, and they sometimes conduct anthropological studies to understand the institutions and norms that drive the interactions among actors, and consequently between actors and their environment. However, the companion modeling approach was conceptualized and then assembled by Europeans. Since the beginning and thanks to the CIRAD mandate, it has been tested in various cultural contexts, in Senegal, Madagascar, Vietnam, France, and then Thailand. These first experiences led to a paradox: on the one hand, the method can be applied in many

cultural contexts and can lead to generic outputs (collective learning processes, a good understanding of computer simulations by stakeholders, etc.), and, on the other hand, the management of the different steps of the method seems to be very dependent on the social and cultural context.

As we decided to use this companion modeling approach in Thailand for natural resource management issues, we did some research on the learning process in Thai traditional culture. How do we understand what villagers believe to be important? What concerns or motivates the villagers? How do they perceive the world in terms of the nature of humans, and the relationship between one person and another, humans and nature, and humans and a supernatural being?

This paper is organized in two parts. The first part aims at identifying and understanding such villagers' worldview through religion, traditional literature and poetry, country music, games and folk plays, ceremonies, and festivals. At the same time, we will highlight rules, plans, and categories that influence how the Thais interpret their social environment and learn to act purposefully within it. This analysis corresponds to the culture from the northeast of Thailand. In the second part of the paper, we try to relate the main observations presented in the first part to the companion modeling approach: Which parts of the companion modeling approach and the associated methodology suit the Thai learning process? Which parts do not suit it? What indications can be derived to improve the methodology and its application to the Thai context?

Fundamental aspects of the learning process in northeast Thailand

Thai ways of thinking

Life is just for fun. One Thai national characteristic that almost all research studies have defined is enjoyment of living (*sanuk*). Thais consider that everything happening in their life is for fun. The person who knows how to do something in a funny way will be socially accepted. Thai folk culture demonstrates well the "just-for-fun" life style. Every step of life, even death, is inseparable from playing. Therefore, working must be done in a pleasant way. When gathering together to work or to celebrate any event, Thais are skilled at creating simple entertainment to cheer up the atmosphere. So, playing serves for both work and social adaptation. In the old days, Thais were mostly peasants and lived in a rural agricultural society in which rice cultivation was the dominant activity. Villagers gathered together to work at critical periods of the rice cycle when widespread labor was needed within a very short time, for example, for soil preparation, transplanting, the harvest, and rice polishing. To keep people working faster and more efficiently in pleasant and relaxed conditions, folk songs were created and chanted among them to provide rhythm and entertainment. During rest hours, peasants sometimes separated into two groups, women and men, and exchanged improvised songs in the form of short and simple poems, such as in "*Phleng Ten Kam Ram Kiew*." They laughed at words or expressions with double meanings or danced together whenever they felt like doing so. After harvesting, they had to prepare the yard for polishing rice. The way villagers trampled on the yard regularly and simultaneously gave birth to "*Phleng Song Fang*." The family that requested help provided food and drink during that special day. This mutual assistance took turns from family to family around the village and normally villagers rarely refused a

request for help from their family or neighbors (Jobkrabuanwan 1982). Folk plays are always accompanied by folk songs and dances. Special characteristics of folk culture are spontaneity, improvisation, simplicity, and outspokenness. Normally, a folk play can take place spontaneously anywhere (paddy field, yard of a house or temple, even on a row boat during the high-tide season) or any time (daytime or night time). The Thai language is characterized by monosyllables and a musical tone that are easily compatible with short poems recited in folk songs. Everyone feels free to participate or not at any moment of the folk play. People can stop playing whenever they get bored. The number of players, women or men, is flexible. The most important aspect is that everyone has the same opportunity to rejoice and have fun (Jobkrabuanwan 1982, Sawadiphanit 1991).

Life as a result of previous meritorious acts. If life is just for fun, then how do Thai villagers manage to cope with serious problems that occur frequently in their lives? Since Thai villagers consider themselves Buddhists, the temptation to act according to Buddhist teaching is still highly valued by their mentality. To understand Thai popular Buddhism in its entirity, one must analyze the villagers' intellectual conception of Buddhist principles and doctrine and specify to just what extent Buddhism motivates their daily actions. For the average villager, concepts such as nirvana, the philosophical intricacies of the *dhamma* teachings, or the involved form of meditation have little meaning. Villagers draw more meaning from karma, rebirth, merit, sin, and *anicang* (impermanence). Villagers understand these concepts in simple terms. They believe in them and, as such, these concepts affect their lives. Villagers are certain that their present existence is the result of accumulated actions, both good and evil, in both their former existence and present one. In their point of view, all human beings are born according to their individual karma and thus one should not be jealous or envious of differences in status, rank, power, and wealth. However, it must be stressed that villagers are fully aware that they can change their present status and condition by their own deeds in the present. Their present actions are directed toward bettering their merit position so as to achieve a better life, both now and in a future existence. For Thai people, a better life means one of riches, power, prestige, perfect health, beauty, and very little physical labor (Suphap 1985). It is in expectation of such a life that merit is earned. If sin is higher than merit on one's karma's scale, then a life of poverty and hardship will necessarily follow. Thus, one views his or her condition with a sense of psychological balance, not rebeling against one's condition of birth while at the same time preparing to change and to view the helping of others as a meritorious act. As the villagers are ever-anxious to build up their store of merit, it is quite natural that they strive to tie the merit label to every act possible. Thus, one is impelled to show kindness toward others and render assistance willingly, show compassion toward others and alleviate their suffering, rejoice with those who are fortunate, avoid envy, preserve equilibrium in the face of other adversity or success, and view all without prejudice or preference, thus appreciating that all is subject to karma (Conze 1961, Klausner 1981).

If something happens in an unexpected or unpleasant way, or some serious problems occur in a way in which it is difficult or impossible to find a solution, the Thais just say "*mai pen rai*" (never mind). Thais are able to say "*mai pen rai*" when facing missed appointments and the lack of successful and timely task completion.

Certainly, Thais find more psychological fulfillment in the chase than in the attainment. For a voyage or journey that is fun, the end result is less important. Thus, one should not be too discontented or concerned if one is some minutes or some hours late. It is preferable to fulfill one's work or to live in a funny way. To comprehend this attitude, one must realize that one of the central concepts of Buddhist philosophy is the *law of Nature*, something which naturally exists. Whether Buddha will appear or not, it is a natural, unchanging truth that all compounded things are impermanent, stressful, and not-self. Impermanence (*anicang*) means that compounded things are constantly being born and dying, appearing, and passing away. Stressful (*dukkha*) means that people are constantly being conditioned by conflicting and opposing forces. People are unable to maintain any constancy. Not-self (*anatta*) means that they are not a self or intrinsic entity, they merely follow supporting factors (Payutto 1995). For the villagers, they believe in the concept of the transitory nature of the material world in which they live and the uncertainty and impermanence of all. Thus, one must realize the futility of worrying about material things or events. Therefore, each provisional situation is considered as a pathway to another provisional one. This will continue successively without ending. Only the enlightenment (*nirvana*) can terminate this cycle of life. But the villagers consider the enlightenment as far beyond their reach, so they are content to attach themselves to life while trying to reduce any stressful suffering by detachment as much as possible from the impermanent nature of the material world.

Confrontation avoidance: social harmony. The Buddhist religion emphasizes the positive virtue of avoiding the extremes of the emotional spectrum. In doing so, Thais believe in performing some meritorious acts. Theoretically, this applies to socially acceptable emotions such as love and friendship as well as socially disruptive emotions such as anger, hatred, and annoyance. Although overt expression of socially accepted emotions is less curbed, it is nevertheless kept well in hand, at least in terms of observable behavior. One endeavors to keep personal relationships and social interactions at a superficial, pleasant, and emotionally neutral level to preserve an aura of emotional contentment. One must not become too emotionally involved, entangled, or engaged, for too deep involvement and attachment can only lead to disappointment and suffering. As happiness translates into tranquillity and peace, to live in a proper and meritorious manner, one should, at the very least, curb the expression of one's antisocial feelings. The fact that villagers live in close and intimate physical and social contact accentuates the need for such behavior. In such an interdependent society in which mutual aid and cooperation are strongly required, overt social confrontation would make it difficult to carry out cooperative activities. Villagers mask their antisocial emotion well and preserve the facade of harmony. A complex of forces within the community is directed at maintaining the set of harmonious human relationships (Klausner 1981).

Even if there is a very strong emphasis in village social life on harmonious human relationships with one's fellow villagers and a concomitant avoidance of overt acts that express anger, displeasure, criticism, and the like, disruptive behavior sometimes does occur. To make others aware of one's anger and discontent, one always uses anonymous ways, for example, by intermediate persons, by folk plays, by folk tales, or even by supernatural beings.

Ceremonies, festivals, and folklore: social control and safety valve

Though the Thais avoid overt conflict, they often harbor this conflict. Since the direct display of antisocial feelings is not allowed, Thais have an infinite variety of ways of revealing them in a subtle, devious, and indirect fashion. For example, while preserving a smiling, friendly manner toward the object of one's anger, annoyance, and disagreement, one may practice various options such as poker-faced sarcasm, avoiding contact if possible, and cooperating superficially but using the fine edge of continual postponement or imaginary roadblocks to avoid the reality of assistance. The indirect expression of one's feelings is exemplified in a social procedure called, in Thai, *prachot* or "projected vilification" (Klausner 1981). The individual who has been hurt in some manner does not express his or her displeasure directly but turns it toward another object. A lady will often reprimand a child, whereas, in actuality, her words are meant to apply to another adult. The other adult is aware that the displeasure shown is directed against him or her. *Prachot* often occurs with animals used as a direct method of expressing antisocial emotions. In this case, one will slap a dog and speak angrily to it, but the words are usually directed at another person who, in return, will punish his or her cat and reprimand it with the same words and tone. It's not only emotionally satisfying to play this game, but one is able to preserve an outward semblance of friendly social relationships. People hope that the one who has offended and caused displeasure will receive the message of social warning and mend his or her ways.

Words of rebuke, criticism, and annoyance directed toward others are pronounced only in the confines of the family, or, if these words are expressed openly, they are masked in the form of folk songs or folk tales. The villagers feel free and secure to conceal their thoughts under unrealistic situations. In folk songs, bard singers criticized the ruling class by chanting about the miserable life of peasants who had to work hard to earn money to pay income tax, or of villagers who had to pay tax for collecting vegetables in the village's pond (Wongthet 1975). Folk tales, a rich heritage of folk culture, have provided the rural masses with a socially acceptable psychological release mechanism for their repressed antagonisms, frustrations, and anxieties against authority symbols. *The Siang Miang tales*, known as *Srithanonchai* in the Central region, provide a psychological release for the frustrations and antagonisms of a peasantry subject to the arbitrary power of the ruling aristocracy. Siang Miang, who was born of the peasantry, conquered officialdom through wit, guile, and deceit. Not only did Siang Miang challenge and ridicule authority, he emerged victorious in the battle of wits with the ruling establishment. Most of the time, rulers must rely on the peasants' cunning and genius to solve problems of state. These tales serve to caution the ruling class to appreciate the value of the peasants' practical, common-sense approach to life's problems (Kaewthep 1996). These tales also serve as instructional models of ideal behavior, again enabling the villagers to indirectly caution their elders, mentors, superiors, and rulers not to abuse their authority and to act in a just and moral fashion so as to justify respect and obedience.

If conflicts are unavoidable, an intermediate person such as the abbot, headman, and family head tries to find solutions that are compatible and flexible for every member of the society. It often appears that the villagers consciously use the spirit world as a means of assuring that harmonious social relationships will be maintained.

For example, family members are cautioned to preserve smooth social relationships, because, if they argue, show anger, and cause constant friction, the family spirit will be offended and will bring misfortune to the family. The supernatural world is always used in a manner that removes the responsibility of criticism and punishment from the shoulders of the villagers in instances in which someone is publicly criticized for committing an action detrimental to village security and stability. Such criticism is expressed through the spirit, who is supposedly offended by such antisocial behavior. Thus, the wrongdoer will be responsible for the misfortunes that may befall the village. He will have to correct his behavior and make amends for it to placate the village spirit. The wrongdoer will try to make amends. It will be very difficult for this person to get angry with his fellow villagers, who have only asked him to follow the decision of the spirit doctor. Thus, the animist beliefs and practices preserve, in a variety of ways, the pattern of serene and harmonious social relationships (Sathienkoset 1957).

Traditionally, the yearly cycle of ceremonies and festivals performs a vital function as a stabilizing social force. This is particularly true in the skyrocket festival (Bun Bâng Fai) in the northeast region in which villagers perform the skyrocket ceremony in May. As might be expected at that time of year, these ceremonies involve assuring abundant rains. Since fertility is a basic theme of these festivals, there are sure to be overt sexual overtones to the festivals. These ceremonies are important for the welfare of the village, not only in assuring adequate rainfall but also in connection with the actual health and well-being of the villagers. The villagers believe that, if they do not hold these ceremonies, ill fortune will befall them: there will be a drought and sickness. In these ceremonies, sanction is given to drinking, fighting, and speaking and acting in sexually improper ways. If men in the same village have borne a grudge silently, that grudge may surface and result in an open fight. Sometimes two villagers that have a history of ill feeling engage in a group fight. Such actions would be severely disapproved of during the rest of the year in the context of a culture in which it is mostly a sin to show dislike, discontent, and hatred and, in which one seldom sees people engage in any angry discussion, let alone a fight. These improper actions are accepted and, in fact, are expected and are forgiven during the festival (Wongthet 1975).

The Thai New Year's festivities or *Songkran*, in April, which coincide naturally with the end of the rice harvest, are normally celebrated at the temple compound. On this day, nobody, particularly women, is allowed to work. Before New Year's Day, villagers clean their house and polish an amount of rice sufficient for family consumption during the festivities. In the morning, young people undertake the ceremony of the "ritual bath" for revered monks, elders, and parents. In pouring a few drops of perfumed water on their raised hands, they wish them a happy and long life. Water symbolically purifies the soul, takes away sins, and brings back mutual forgiveness, compassion, and reconciliation to the family or local community. Later, in the afternoon, is a time for a *safety valve*. The ceremonies and festival offer more than just an opportunity for gaining merit and having fun. They also serve as an acceptable channel for giving vent to suppressed feelings and carrying out activities that ordinarily are not sanctioned in the village. Thus, women, who traditionally are not allowed to drink, to enjoy themselves in public, or to talk about sex, take the liberty to do all forbidden acts publicly once a year. This unusual habit is very helpful for keeping them in their place during the rest of the year! Once the social pressure decreases, people return

to their normal life with more capability to discuss or overcome problems. These aspects are an integral part of the ceremony and festival pattern of the village. Even if not consciously realized and expressed thusly in any study of village ceremonies and festivals, these social and cultural aspects cannot be neglected.

The Thai way of learning

In the social context that overt criticism of someone is bad manners, Thai learning behavior consists of listening, observing, imitating, and repeating, and gives importance to "experience first, theory after."

Listen, imitate, and repeat. Long ago, only a few knew how to read and information was not attainable by everyone. To get people informed, *Pho Phleng* and *Mae Phleng* (wordsmiths who had skill to improvise poetic songs) were in charge of passing on useful and practical information on special occasions. In southern Thailand, a group of wandering poets came to the villages to announce the end of the year and new events for the following one. The broadcast information was composed of memorized songs called *Phleng Bork*. Villagers became informed about when and how to plow their land and sow rice. Rice varieties were selected according to the rainfall conditions of each year. Wandering poets also predicted a good, average, or bad harvest depending on normal rainfall distribution or drought. This information was taken from sacred books belonging to a few elite persons or monks in the community (Patamadit 1983). It is common to notice local bard singers who are capable of reciting hundreds of poems or reproducing new ones without knowing how to read any words. Nevertheless, the words used in these poems are surprisingly smart, witty, and sensible. These singers enjoy a certain prestige because of their knowledge and their genius as professional wordsmiths. Their knowledge includes both current events and religious lore, philosophy, local history, and customs.

Folk tales are also the source of popular wisdom. Folk tales teach and caution proper respect and reverence for one's parents, superiors, and elders. Often, the spirit world will be called upon to attest to the validity of such cultural imperatives. Clear explanations of the cause and anticipation of the effect are strongly emphasised in folk culture's transmission. It is clearly indicated that, to maintain harmony in society, all people have to do their best to meet the obligations of their social class. Doubt, questioning, and discussion are considered as a lack of respect toward elders. Therefore, misfortune could befall the one who manifests his or her ill respect. Sometimes, the sin is so serious that all the community receives punishment. Whenever there is drought, flood, or famine, these events are believed to be the effect of an immoral governor who does not govern the country with good dhamma, transparency, and justice, or of laymen who do not well respect Buddhist precepts or violate certain laws of the community.

If one persists in acting uncommonly or disobediently, society will restrict that individual by condemning that person as a fool or haunted by bad spirits; therefore, he or she has no right to stay in the community. Two solutions could be found: chase away the bad spirits by using supernatural power or exile that person. Normally, after receiving a series of traditional curative treatments (beating, threatening), the haunting spirits are supposed to be frightened and obliged to leave the body. The person is cured and becomes normal and regains the right to stay in the community. Social

excommunication is the final sanction used in the case of persistent behavior. Many examples are seen in the north and northeast region (Kanjanaphant 1984).

Experiences. Exile is used not only as a way to eliminate social rebellion, it is also the crucial step in life that permits young men to grow up. But does growing up mean that one has to revolt and be exiled before returning to normal life? This way of thought is in contradiction to the concept of avoiding overt social conflict in Thai culture. Folk tales can reveal this contradictory aspect. In studying folk tales, we can illustrate the predominant themes existing in the stories as follows: the hero has to leave his birthplace for an adventurous journey to gain experiences and supernatural power, then return to his original place to impose his authority. Adventure, experience, and discovery seem to be the central interest of the audience.

Adventure is considered as the best education for life. The experiences that the hero gains are real and more important than knowledge acquired by listening to others. Departing for an adventure means that the hero has to face unexpected problems. Uncertainty is unavoidable in life. The capacity to react to uncertain and unpredictable events in a successful manner is more important than theoretical well-planned work. The famous Thai proverb "(Listening to) ten mouths does not equal what is seen with one's own eyes" confirms this idea. In rural society where oral tradition is still the most efficient way to popularize information, knowledge does not come from textbooks or theoretical discussions. Laymen acquire their knowledge by doing and experiencing. The villagers learn by participating in the activities that elders undertake. First, they observe, select, and reproduce by imitating the activities that serve them best. Later, they add new techniques or new elements discovered during their repetitive work or picked out from others' way of doing. "Try to see whether it is good or bad" are key words for the layman's learning process. Through this way of learning, elders are the most valuable human resources. Elders acquire knowledge by risky experiences undertaken during their entire life, and only in that way do they become venerable. So, the knowledge transferred by elders is normally more credible than that from the young because elders have spent a longer time testing, selecting, and modifying their knowledge. Young people, though possessing academic knowledge as well as information and news of the world beyond the village border, do not yet enjoy prestige and influence. However, as a youth, one must act properly in relation to one's parents, monks, and elders if one is to be accorded respect when maturity and seniority are finally reached.

Collective information. In the past, for other kinds of news such as political, social, or economic news, whenever villagers got news from any source of information, they did not believe it totally without verifying it. In the northeast, they had a special process for verifying information called *sokan*. First, they gave high credit to the person who broadcast the news. If that person was credible, the news was believable. In rural society, in which social behavior was tightly controlled, villagers recognized highly credible persons. Normally, these were the abbot, senior, and heads of the village or schoolteachers. Villagers came together at the village's temple or school to discuss and analyze the news with these people. The abbot or chief of the village often became a referee or jury in these circumstances. These people first asked everyone to give his or her idea, to present strong and weak points, and then to choose together the best solution. The community considered it each person's responsibility to broadcast and

verify news. The most important news always concerned food, for example, the time to catch fish in rivers, collect vegetables, hunt in the forest, or slaughter a buffalo or a cow, so that village members could participate in the activities in time. If some people got the news and kept it for themselves, the community punished them by boycotting them: these people were not informed of any news for the next occasions (Sawadiphanit 1991).

Implications and observations from concrete experiments

The analysis presented above points out many features that are important for understanding both individual and social behavior of northeastern Thai stakeholders in general. More precisely, it gives insight into the way stakeholders may perceive the companion modeling approach and act during the collective learning process. In the discussion below, we try to relate the above analysis to the theoretical elements of the companion modeling approach. For this discussion, we also extract some observations from three experiments conducted in 2002 and 2003 in northeast Thailand (see Suphanchaimart et al, this volume). While establishing these relationships, we try to propose some lessons for the use and adaptation of the companion modeling approach.

We divide the discussion into three parts. The first part discusses the individual features and the second part discusses the social influence. The third part discusses the uses of artifacts for collective learning processes.

The individual path

A very important aspect presented earlier is the concept of karma and merits, which is the foundation of autonomous behavior. In addition to this notion of given karma is the role of individual experience in the learning process. Each individual has to gain experience by himself/herself and learning comes from experience. Although learning and experience are essentially individual, observation and imitation of others are also considered in the learning process. The role of theory and discussion is not as important.

These elements correspond with what was observed during the role-games in the villages. The players took part in the action proposed by the role-game in a very individual way. Certainly, in the game, farming is an individual activity that can be done without exchanges. However, few discussions on crop choices occurred during the experiences. Imitation processes may have occurred during the role-games. For example, during the games, some farmers introduced farm ponds in their fields. During the following steps, other farmers gradually introduced ponds on their farm, but there was no discussion about that (at least visible discussion). During the games, farmers experienced original land uses. In one game, one farmer used his plots for fishponds. Another farmer split his land in two to have orchards on the upper land and rice in the lowland. These experiences were certainly observed by the other players, but not discussed. This is consistent with the notion of individual autonomy, whose foundations are presented above.

Because of this autonomy and the emphasis on the individual path, there seems to be less room for what Jager (2000) calls social comparison in the individual decision-making process. Social comparison means that a player will quantitatively and socially

compare his/her conditions with another stakeholders' conditions. The observations made during the experiences confirm this. We did not observe farmers' decisions based on discussed quantitative comparison. This can be observed also during the other steps of the companion modeling approach. First, it is almost impossible to have group discussions on the behavior of such or such a player (we will come back to that point in the next section on social control). Second, during the individual interviews, even if one player knows what the other players did during the game and can restate it, he/she will not easily comment on behaviors, reasons, and differences.

Thus, the role-game method that is used as a step of the companion modeling approach seems to correspond well with the individual learning process at stake in northeast Thailand. This leads us also to think that the individual process of social comparison is very difficult to investigate. Companion modeling seems to be a relevant approach but the first experiments do not show its efficiency for that purpose.

Social structure and social control

The second important aspect discussed earlier is social control. The structure of Thai society appears clearly during the experiments. There are different classes of stakeholders: farmers, traders, administrators, researchers. Mixing people from these different classes in a common role-playing game is something very challenging that needs to offset some perceptions of the society. The first challenge is to invite together stakeholders from different social statuses. A role-playing game corresponds to an arena of social confrontation where people will be forced to interact, as in reality. If there are no interactions in reality, no interactions occur during the role-playing game. This is what happened during the experiments. Invited stakeholders coming from upper organizational levels did not participate at all in the role-game but delivered a discourse after the experiment. What makes these tensions acceptable is the fact that the game is *sanuk* (fun). Some transgressions of the social structure are possible during the role-game. This will be discussed in the next section.

Among members of the same social classes, social control is also very strong because of the social harmony principle. One should not express an opinion on differences in results with other actors. One of the companion modeling principles is that this modeling should help in collective discussion. In other cultural contexts, collective debriefing of role-games is very important: players explain the reasons for their choices, which helps in the common understanding. During the role-games, we never succeeded in having the collective discussions. Stakeholders cannot collectively justify their own actions (which may show too much self-esteem) or comment on others' actions (underestimation of the others). Stakeholders cannot express any comment that could be interpreted as a competition. For that aspect, the companion modeling approach is not suitable. However, surprisingly, the computer multi-agent systems (MAS) model can be helpful for this aspect. During the experiments, we realized that we had good discussions when we presented the simulations as "actions of other players." Then, the stakeholders were active in commenting on the observed actions. For instance, surprised by actions observed at the interface of the model, they said, "these players are not Lao," which relates the players' actions to their culture.

The last point discussed here is the importance of the social network. As stated earlier, social harmony is based on the stability of the social network. Several obser-

vations during the role-games confirm this conclusion. We give here two examples observed during the role-games. In September 2002, an important trader was invited to play with the farmers. When the game took place, we realized that the middleman who usually acts as an intermediate between the farmers and the trader was playing the same role in the game, and that the selected players were actually members selling sugarcane to this trader in reality through the quota leader. This allowed the trader to stay relatively apart from the farmers during the game, but to control the sugarcane exchanges. The second observation occurred during a game in April 2003. We realized that the players acting as middlemen between the factory and the farmers and who were supposed to compete for sugarcane were in fact exchanging sugarcane among themselves in a complex and not economically rational way. When interviewed about that fact, the players explained their kinship relationships and expressed the need for sharing the resources among the stakeholders. Thus, the earlier analysis and observations during experiments converge to emphasize the very important role of social structure. The maintenance of the social structure is a very important objective of the players, and it is a means for performing the actions proposed by the game. The consequence for the companion modeling is that the organizers have to analyze the social structure of the group they will play with, and strengthen markedly the ability to observe and analyze the interactions among stakeholders during the game.

Tools for mediation

The companion modeling approach proposes the use of two kinds of artifacts, role-playing games and computer simulations, to mediate the discussion and enhance the collective learning process. How do stakeholders perceive these artifacts? How relevant is this idea of tools for mediation in collective learning processes?

The first point we discuss in this section is the difference between reality and artifacts. It appears from the observations during the experiments and from the interviews the day after that it is very difficult for players to differentiate reality and role-playing games. The participants play in the game like they act in reality. The game imposes some constraints that they do not have to face in reality and, conversely, the game does not reproduce the full complexity of reality. However, during the individual interviews after the game, we noticed that the players did not understand well why we asked two times what is their decision-making process, in reality and in the game. The differences that can be discussed are the differences brought about by the structure of the game and not by the decision-making process. This commitment in the game is observed in all the countries where we played role-playing games. But it seems to us that in northeastern Thailand this assimilation between virtuality and reality is much stronger. This may be related to the *anicang* (impermanence) concept of Buddhist philosophy. Life itself is one experience among others, one scenario among others. The role-playing game proposes another kind of virtuality and the gap between the role-playing game and reality may be less important than in other cultures.

This has consequences for the second point: What is the possible use of the companion modeling approach? Players act in a way similar to how they act in their reality. The realism is individual but also collective. As discussed, players bring into the game their individual decision-making process and their social structure and their social control system. Thus, it is difficult to use the game as a virtual world in which

new rules could be discussed. We have seen in other contexts (Gurung et al, this volume) that during the games interactions occur that are almost impossible in reality because the game offers a virtual world offering some freedom, especially social freedom. Earlier, we saw how Thai culture offers some room for the expression of feelings. First is the *prachot* procedure (the role of the intermediary). Second is the role of festivals, which can be used for the transgression of social rules. This happened one time during the experiments in the village. One farmer, a lady, expressed in a very funny way her dissatisfaction with the "big trader." She did it in a very theatrical way to show with her body language that it was for fun. Everybody laughed, but of course there were no consequences or at least no discussed consequences. This corresponded more to a process of reduction of pressure, as explained earlier, rather than a commitment in a collective discussion to possible changes. Thus, one could expect the role-playing games to be used as an intermediate, or a mediator, to express feelings and create a new world in which discussions could be possible. This does not happen and seems to be very difficult because the game and reality are too closely related. Thus, the collective learning process is also socially controlled. For that aspect, during our experiments, we did not take into account the *sokan* (process of verifying information) principle, as explained earlier. The experiments took place at the Tambon Administrative Organization, which is a relatively new organization in charge of the local management of resources. This organization did not play any role or express any interest in the process. Thus, before organizing companion modeling experiments, one should try to understand who the reference persons and institutions are for the collective learning process. Again, this emphasizes the need to understand the social system with which we interact.

The last point that we discuss here is the concept of scenario. The companion modeling approach stipulates that the players should collectively propose scenarios of change, which may happen or which they would like to test. But, during the three experiments we carried out, this did not happen. When requested for scenarios to simulate, in the game or in the model, the players were unable to propose anything. This can be partly related to the social control discussed above, which does not favor the expression of ideas on what the system could or should be. But this was not successful also during the individual interviews. One can relate this again to the karma and the *anicang* (impermanence) concept, that actual existence and its events are due to past actions, the uncertainty and impermanence of everything, and the importance given to the journey rather than the achievement. The expression of a theoretical scenario is thus very difficult to achieve. However, this reinforces the importance of the role-playing game. Players do not propose scenarios, but they act out scenarios. During the experiments, we could observe innovations in the introduction of new crops, farm ponds, a new allocation of land, new activities such as fisheries or integrated farming, and new systems of exchange. Players also react well to scenarios imposed by the organizers such as changes in the prices of commodities. They do not comment but they adapt their behavior.

As a brief conclusion to this section, we realize that the distinction between the game and reality is very fuzzy, that the companion modeling approach facilitates the collective learning process through experience and observation (among players themselves and between organizers and players), and that one should not expect much

collective discussion. With the kind of realistic games proposed, virtuality cannot be used by the players to step back and collectively discuss reality.

Conclusions

Our conclusions are drawn from our better understanding of some Thai cultural aspects that concern the learning process and the relationships with virtual reality, and from the first experiences we had while applying the companion modeling approach. As this is the first analysis, we cannot be very firm in our conclusions but rather can give some indications.

- The tools proposed by the companion modeling approach are suitable to the Thai cultural background because this method is based on tools that use experiences and games. Experience with and observation of others are the main driving forces of the collective learning process. Thai learning behavior gives importance to "*experience first, theory after*." Thais learn by listening, observing, memorizing, experiencing, imitating, and repeating. Furthermore, the fun aspect (*sanuk*) is of great importance in the learning process.
- The collective discussions that are supposed to emerge from the use of these tools in the framework of the companion modeling approach do not really occur. This is due, on the one hand, to a convergent effect of individualism, strong social structure, and a fundamental culture of conflict avoidance, and, on the other hand, to the great difficulty in distinguishing reality from virtuality and theorizing scenarios.

Although these first indications should be confirmed by new experiments, scientific discussions, and more theoretical investigations in social sciences (on the concept of scenarios, for instance), preliminary recommendations can be derived from this work. The first is the importance of the social organization. One should have a good knowledge of the social organization before playing the game. Emphasis should also be given to the observation of social interactions during the game. This task requires the involvement of well-trained social scientists. The second recommendation is to emphasize experience, both individual and collective. Culturally, people learn individually and collectively by experience and observation. Involvement in role-playing games and the interactive use of simulations correspond to that behavior. It is also through games that people express scenarios and adaptations to external constraints. This guides us to adapt the companion modeling approach so that it will emphasize role-playing games, lead to game organizers proposing scenarios of change, and use computer simulations more interactively.

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Notes

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Training on multi-agent systems, social sciences, and integrated natural resource management: lessons from an Inter-University Project in Thailand

F. Bousquet and G. Trébuil

In this new century, there is an urgent need to integrate and organize knowledge into suitable frameworks to examine essential problems with the people involved in solving them. Recent advances in computer science, particularly distributed artificial intelligence and multi-agent systems (MAS), are creating a strong interest in using this new knowledge and technologies for various applications to better deal with the increasing complexity of our fast-changing world, particularly for studying interactions between societies and their environment. By emphasizing the importance of interactions and points of view, the MAS way of thinking can facilitate high-level interdisciplinary training and collaborative research among scientists working in ecology and social sciences to examine complex problems in the field of integrated natural resource management (INRM).

This paper describes how a recent project based on a series of short courses in the field of MAS, social sciences, and INRM at three different universities in Thailand tried to transfer European expertise and research results to an Asian audience of graduate and postgraduate students and young researchers interested in innovative and action-research–oriented interdisciplinary approaches. The course structure, organization, and contents are described and assessed. The course participants are characterized and their opinions are used to evaluate the strengths and weaknesses of this very interdisciplinary training program.

The first sustainable outputs and key preliminary lessons learned from this innovative collective learning experience are presented. In conclusion, the authors suggest ways to support the emergence of a regional network of "MAS for INRM" practitioners in Southeast Asia to build on the dynamics begun by this project and serve the need for such interdisciplinary training across Southeast Asia.

In this new century, knowledge management faces two major challenges. The first one deals with the adequacy between globalization and fragmented knowledge among disciplines on the one hand and multidimensional realities requiring transdisciplinary approaches on the other hand. The second challenge is the continuous and accelerated improvement of knowledge in many fields, which is making knowledge organization more and more difficult to achieve but also more and more crucial for students and educators. There is therefore an urgent need to integrate knowledge across scientific disciplines, as well as with other sources of information, into suitable frameworks

to examine essential problems with the people involved in solving them. Nowadays, it is necessary to give equal importance to stakeholders' opinions, traditional representations, and science-based information. Principles to organize knowledge to face the challenge of complexity, uncertainty, and fast changes are required. Edgar Morin (1999), who spent many years studying complexity issues, considers that training students to establish linkages among knowledge from different disciplines and sources is of paramount importance for the next generations.

In the field of renewable natural resource management, adaptive management is required to deal with complex and unpredictable situations (Holling 1978, Lynam et al 2002). The functional integrity of the ecosystem can increase in parallel with the adaptive capacity of resource managers. Particularly, this can be achieved through a better coordination among these managers and a greater collective ability to recognize and agree upon points of intervention to improve the sustainability of resource management (Ostrom et al 1994).

At the same time, modeling is increasingly seen as a suitable approach for examining complex resource management problems. In this field, it is now widely accepted that modeling should proceed iteratively, by successive approximations, usually from simple to more complex representations of the system dynamics. Far from being the work of scientists in ivory towers, these iterative, applied, and action-research–oriented modeling activities should be implemented in close interaction with field work and stakeholders looking for solutions to the real-world problem under study. Stakeholders should play an important role in the construction and the validation of such models. Later on, they should be able to use them with scientists to explore the effects of different options and scenarios of resource use to negotiate and reach a compromise on suitable rules and action plans to be implemented collectively. We call the "companion modeling" approach (Bousquet et al 1999) such a collective learning process for INRM. While it is usually easier to find scientists in the fields of agroecology and biology to analyze a specific resource management problem from their point of view, there is still a need for capacity building in the "softer" field of social sciences to examine such problems with "hard" scientists, and for training both types to collaborate in a truly interdisciplinary and innovative "third" way (Röling 1999).

Recent advances in computer science, particularly in the fields of distributed artificial intelligence (DAI), agent-based modeling (ABM), and multi-agent systems (MAS), have created a strong interest in using such innovative technologies to examine complex issues and better deal with the increasing complexity of the real world. MAS are computational systems relying on the technology of cellular automata, in which various autonomous agents interact in a given environment. They are based on the principles of distribution, interaction, and control (Ferber 1999). More information on MAS can be found in the introductory chapter of this volume by Bousquet and Trébuil. Recently, significant progress has been made in simulating societies in interaction with their environment (Gilbert and Troitzsch 1999, Jager 2000, Moss 2002) and innovative approaches such as MAS can create artificial societies (Weiss 1999).

MAS simulations are being increasingly used to deal with ecological and socioeconomic issues arising from the management of scarce resources by multiple

users (Janssen 2002, Bousquet and Le Page 2004). When this approach is applied to INRM problems, such as when modeling situations of conflict among stakeholders, the effects on the resource dynamics of the interactions among different agent behaviors and the associated feedback effects can be simulated and tested. Modelers use these methods to create computer representations of dynamics observed in the field.

The MAS way of thinking emphasizes interactions and diversity of points of view for analyzing interactions between societies and their environment. It could facilitate the design of high-level interdisciplinary training and research among ecologists and social scientists working in renewable natural resource management and on INRM problems. Many case studies examining concrete resource management problems have recently started in several Southeast Asian countries and a sample of them are presented in the contributed chapters of the present volume.

Today, these problems at the interface between the environment and society are frequent in the fast-growing economies of several Asian countries, particularly in situations where limited, or even shrinking, natural resources are exploited for multiple uses by competing users. Many examples in forest, water, and biodiversity management, etc., are regularly making the headlines of local newspapers. At the same time, there is a trend toward the decentralization of natural resource management. For example, in Thailand, Tambon (subdistrict) Administrative Organizations (TAO) have been installed across the country under the new "people" charter approved in 1997 and are managing an increasing share of the public budget. It is therefore urgent to train a new generation of natural resource managers equipped with approaches, concepts, methods, and tools to face the increasing complexity and uncertainties of situations at the grass-roots level. They should be able to organize and interconnect knowledge from various sources to rapidly manage changing ecological and socioeconomic environments and avoid the occurrence of acute resource management conflicts.

To contribute toward such a goal and as MAS for resource management are still little known in Southeast Asia, in October 2001, we implemented a training project composed of a series of eleven short courses on MAS, social sciences, and INRM that were organized in rotation at three public universities in Thailand: Chulalongkorn, Chiang Mai, and Khon Kaen universities. It was financially supported by a grant from the Asia IT&C initiative of the European Commission, the French Cooperation, the International Rice Research Institute (IRRI), and the Centre de cooperation internationale en recherche agronomique pour le développement (CIRAD).

Objectives

This article describes how this interdisciplinary training project was designed and implemented to transfer European expertise and research results in the field of MAS, social sciences, and INRM to an Asian audience composed of mainly graduate and postgraduate students or young researchers interested in interdisciplinary approaches to research in the field of renewable natural resource management.

Following a presentation of the course structure, organization, and contents, the way the project is improving knowledge and technology cross-flow and the management of interdisciplinarity is assessed. An analysis of the participants and collaborative institutions is made. Their inputs helped to evaluate the strengths and weaknesses of the program design and mode of implementation. Its effects on the extent of partner-

ships in this fast-developing scientific field are also described. The presentation of the first sustainable outputs of this project and useful lessons learned to facilitate the implementation of similar training activities in Southeast Asia in the future are also dealt with. Finally, several perspectives and prospects for reinforcing the momentum created by these training activities are suggested.

Materials and methods

Sources of information

The information analyzed in this article comes from various sources and materials. The initial project document (Bousquet 2001) was used to present the design and organization of the course. A series of successive training reports produced after each successive short course was used to analyze the participation and to monitor trainees' progress. The project database on trainees and their institutions provided information to prepare several figures illustrating this paper. The series of course evaluations by the participants carried out upon completing each of the 11 training sessions held from October 2001 to April 2004 was the main source of information to analyze trainees' needs, the relevance of the concepts and topics presented by the instructors, and the strengths and weaknesses of these short courses. Individual interviews with six core trainees who attended at least six courses were also conducted during the preparation of this article. The topics discussed during these interviews were as follows: efficiency of the transfer of knowledge and know-how, assessment of the organization and management of the courses and suggestions for improvements, management of interdisciplinarity, emergence of sustainable outputs and impact of these courses, and new partnership mechanisms emerging from the project activities.

The following indicators were monitored to assess the transfer of knowledge and know-how during the training process: evolution of the participation (number and educational background of trainees and collaborative institutions), number of trainees' own applications being developed, number of trainees' M.Sc. and Ph.D. research proposals and theses integrating the MAS approach, number of complementary MAS training courses taken overseas, and number of university courses including presentations of MAS for the INRM approach.

Course structure and organization

Figure 1 displays the general structure of this interdisciplinary training process, which took advantage of the respective expertise available at the three collaborating Thai public universities to organize each of the successive short courses.

Apart from the 2-week introductory course on MAS for social sciences and INRM, all the following ones were 1-week training sessions. A different instructor led each course. These instructors are specialized in diverse but complementary fields and are all recognized as leaders in their respective scientific areas. Almost all of them are members of a European community of scientists working on social simulations. Table 1 shows the scheduling, location, main themes, and key concepts introduced during the 11 successive short courses offered under this project.

Different combinations of teaching methods and tools were used during each course. Generally, on each day, two 90-minute lectures alternate with presentations of case studies, group exercises, hands-on exercises, or personal work. A large quantity of

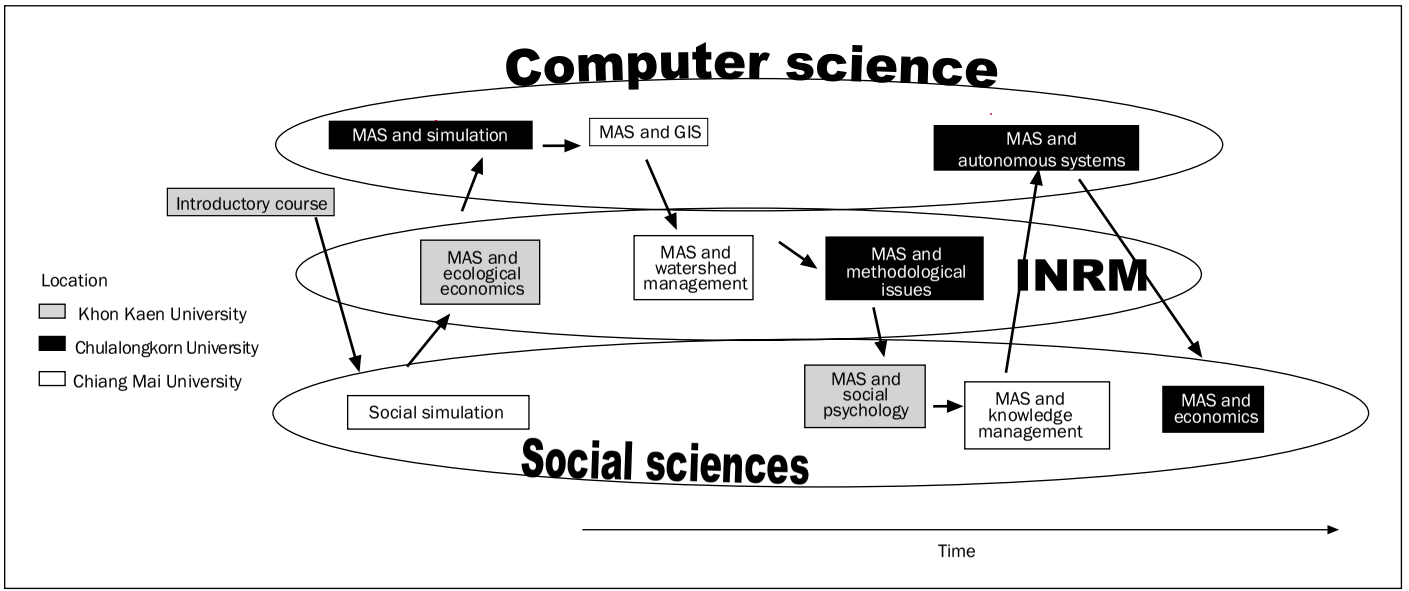

Fig. 1. General structure of the interdisciplinary training course on multi-agent systems, social sciences, and integrated natural resource management in Thailand.

visuals were used as most of the sessions rely on video projections. At the beginning of each course, all the slides used by the instructors, a series of key reference papers for further reading, a CD with these files, and the software used during the course as well as the computer exercises were provided to the trainees.

Networking, exchanges, and group dynamics were sustained by the subscription of each trainee to a global electronic discussion list (with a Q&A service) linked to a Web site specifically designed for MAS users in INRM (http://cormas.cirad.fr). On this site, trainees could find more information (reference papers and tutorials, completed case studies, new versions of software, opportunities for further training, etc.) and particularly a library of already developed MAS models providing more inspiration.

Contents

Following the main introductory course, the successive course instructors presented different disciplinary points of view, key concepts, and experiences on the use of MAS in social sciences and INRM (Table 1). Because several new concepts were introduced during each course and all the sessions were conducted in English, the contents were rather difficult to follow for some participants. The use of MAS simulations by all instructors established a link between sessions.

The teaching and use of the CORMAS (common-pool resources and multi-agent systems) simulation platform in most of the courses is another important linkage. Provided free to all participants, this simulation platform is the key reference computerized tool used in this program (Bousquet et al 1998, see also the contributed chapter on CORMAS by Le Page and Bommel in this volume). Vensim, NetLogo, and SDML (Strictly Declarative Modelling Language) were other software packages also introduced during these short courses.

As soon as this project began, the participants were encouraged to conceive, design, and gradually build a personal application on a concrete problem related to their academic interest or professional activity. In the middle of the week, time was made available to work on these personal projects through interactions with other trainees and the instructors. The last morning of each training session was frequently allocated to the presentation of several trainees' applications, each one being followed by a collective discussion and comments from the instructors. This was very useful because the quasi-absence of completed case studies in Southeast Asia at the beginning of this program limited the illustration of lectures by examples dealing with local problems in Asian contexts.

Participants and their institutions

Most of the trainees were graduate and postgraduate students, young or more senior university researchers, but also officers from development-oriented government agencies of the Thailand Ministry of Agriculture and Cooperatives (MOAC) who were interested in interdisciplinary and applied approaches to research in the field of participatory resource management. Figures 2 and 3 show that these trainees came from 11 countries and many more institutions. Of the current total of 85 participants, Thailand (47), the Philippines (14), and Vietnam (7) were the main contributors. The presence of a small minority of European trainees in several short courses had a posi-

Table 1. Contents of the Asia IT&C initiative training program on multi-agent systems, social sciences, and integrated natural resource management, Thailand, October 2001-spring 2004.

Step no.	Month /year	Location /univ.[a]	Main theme	Main instructor/ institution	Key concepts introduced
1	Oct. 2001 (2 weeks)	KKU	Introduction to MAS for INRM	Dr. F. Bousquet IRRI-CIRAD, Thailand	Overview of the main concepts
2	Feb. 2002	CMU	MAS & social simulation	Prof. N. Gilbert University of Surrey, UK	Simulation in social sciences, emergence
3	Apr. 2002	KKU	MAS & ecological economics	Dr. M. Janssen Vrije Universiteit, NL	Resilience, models in ecology & economics
4	Apr. 2002	CU	MAS & computer sciences	Prof. A. Drogoul Paris VI University, FR	Agents in computer science, distribution
5	Oct. 2002	CMU	MAS & geographic information systems (GIS)	Dr. S.P. Kam, IRRI, PHIL Dr. C. Le Page, CIRAD, FR	Spatial dynamics, scaling issues
6	Oct. 2002	CMU	MAS & integrated watershed management	Dr. O. Barreteau Cemagref, Montpellier, FR	Integrated modeling, companion modeling
7	Mar. 2003	CU	MAS & the environment: methodological issues	Prof. S. Moss Manchester Metro. Univ., UK	Validation of models, abstraction
8	Apr. 2003	KKU	MAS & social psychology	Dr. W. Jager University of Groningen, NL	Social psychology, decision-making processes of agents
9	Oct. 2003	CMU	MAS & knowledge management	Prof. N. Röling Wageningen University, NL	Tools for participatory decision-making, soft science
10	Mar. 2004	CU	MAS & autonomous systems	Dr. J.P. Muller CIRAD, Montpellier, FR	Autonomy, learning in computer science
11	Apr. 2004	CU	MAS & economics	Dr. A. Kirman, Greqam Aix-Marseille Univ., FR & M. Antona, GREEN CIRAD, FR	Decentralized economics, public policies, & publicaction

[a]CMU = Chiang Mae University, CU = Chulalongkorn University, KKU = Khon Kaen University.

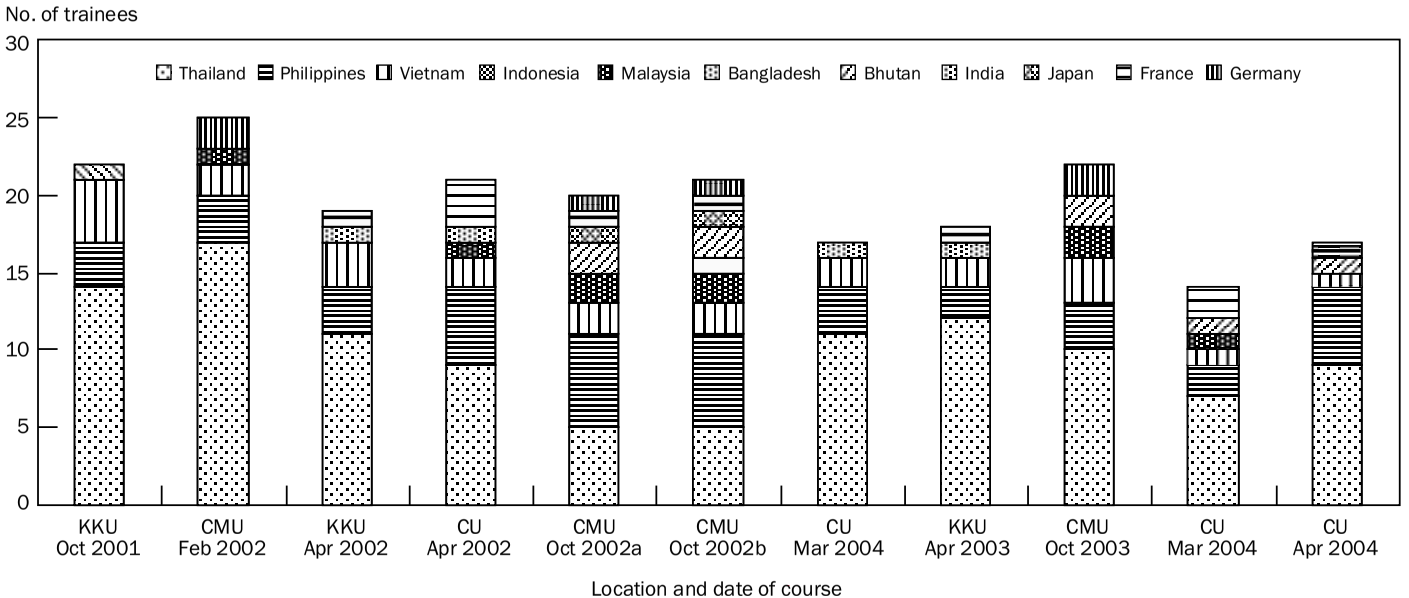

Fig. 2. Number and country of origin of the trainees who took part in the short courses of the interdisciplinary training program. CMU = Chiang Mae University, CU = Chulalongkorn University, KKU = Khon Kaen University.

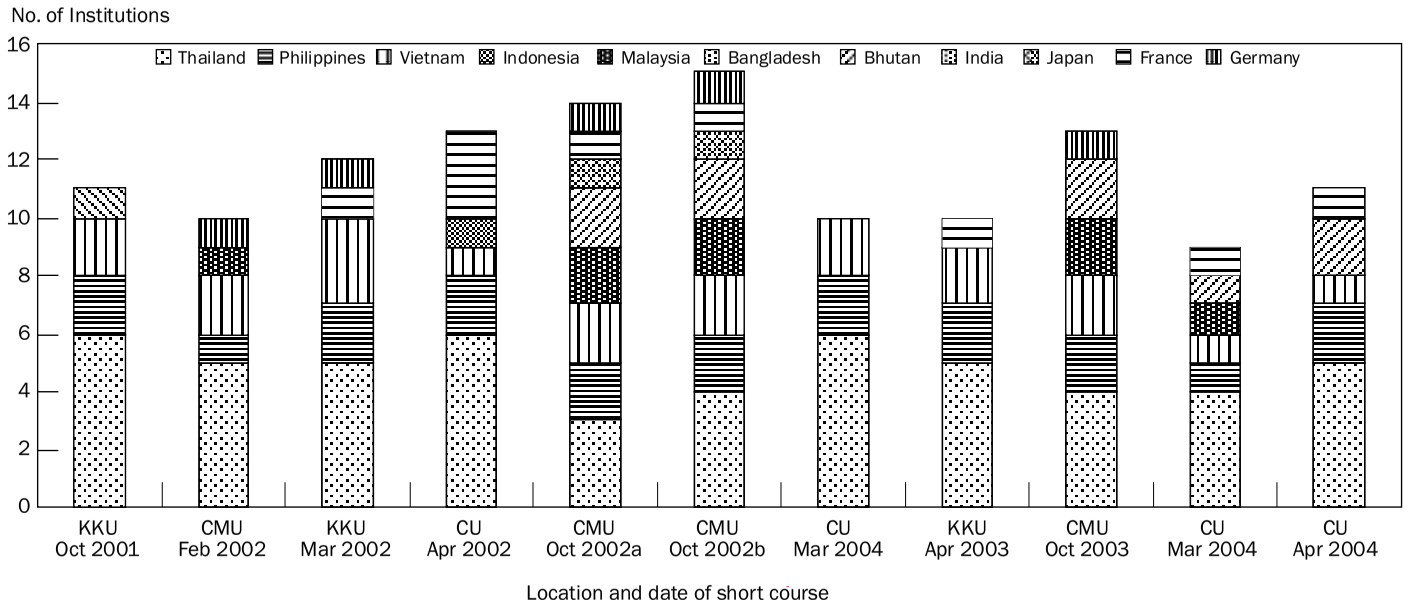

Fig. 3. Number of collaborating institutions by country in the short courses of the interdisciplinary training program. CMU = Chiang Mae University, CU = Chulalongkorn University, KKU = Khon Kaen University.

tive effect on the group dynamics through the sharing of different viewpoints and the establishment of new professional contacts.

Trainees applied electronically to attend a particular short course, but many new ones were colleagues of former participants. No special advertising for these courses was done as the target size of the audience was limited to 16–20 full trainees per session plus several observers. This limited group size was set up to guarantee the quality of the support provided by the trainers, particularly during computerized hands-on exercises on new software or the design and construction of personal case studies.

The heterogeneity among the trainees, in terms of background knowledge about MAS, social sciences, and INRM, was important and tended to increase over time. Figure 4 displays the initial field of specialization of the trainees. This diversity of educational background among the trainees responded to a similar diversity of specialization observed among the main instructors.

At completion of the training process, three types of participants could be distinguished:

- A core group of regular participants who attended most of the short courses and who were also developing personal applications based on their new knowledge.
- Less regular participants who joined only the short courses dealing with themes of their interest; most of them were not involved in building their own applications.
- Observers who just wanted to familiarize themselves with MAS and attended one or several courses depending on their main themes.

Table 2 shows the changing sizes of these subgroups during the training process depending on the specific theme of each short course. In general, each course was attended by around 10 to 12 core participants, 6 or 7 less regular participants, and 2 or 3 observers. The management of such heterogeneous groups was a challenge for the trainers.

Results and discussion

Strengths and weaknesses of the training process

The following analysis is based on a review of the course evaluations by the participants. Table 3 shows that the overall course effectiveness assessed by the trainees was very satisfactory.

Organization and structure

Strengths. The diversity of disciplinary backgrounds among the different course instructors, all having the MAS approach and tools in common, could be seen as a "unique opportunity" (as one core trainee put it) to become familiar with MAS and their use in various fields. The organized interactions between trainers and trainees having a chance to interact with specialists about their own personal projects also received high marks. The choice of presenting a whole research approach and process during a five-day short course was also appreciated. Participants had time to discuss

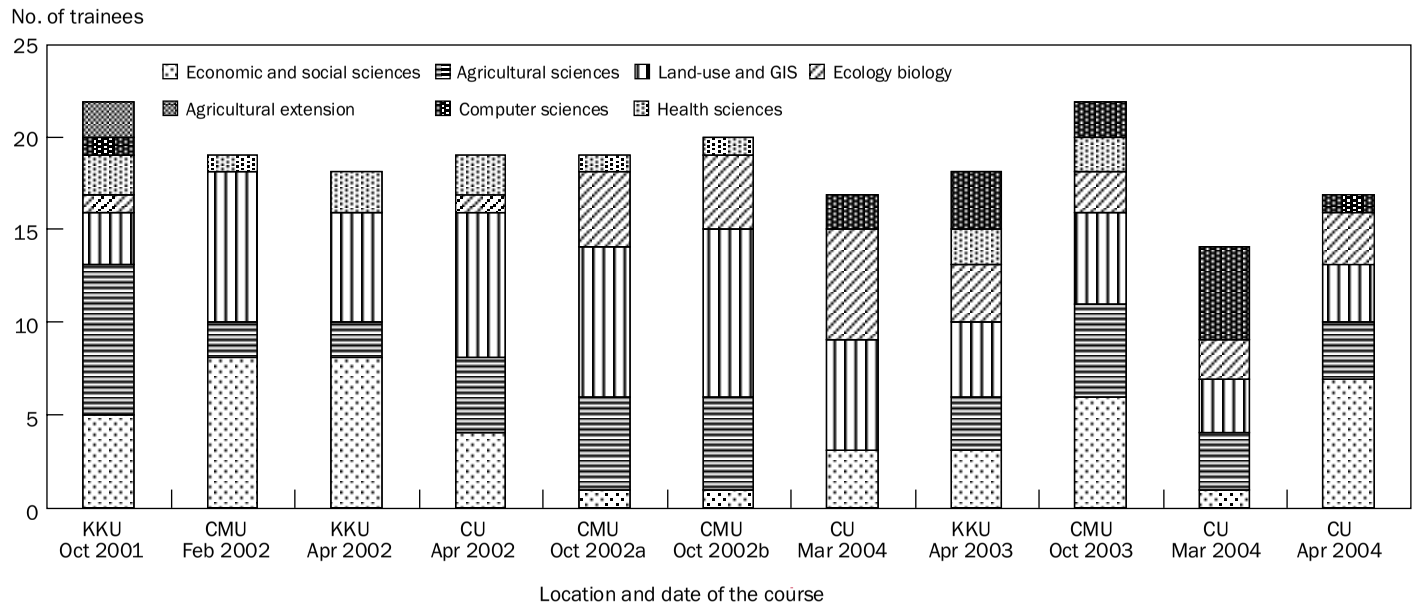

Fig. 4. Academic background of the trainees who took part in the short courses of the interdisciplinary training program. CMU = Chiang Mae University, CU = Chulalongkorn University, KKU = Khon Kaen University.

difficult topics and to integrate relevant new knowledge into personal applications that were gradually built between successive courses.

The courses were held between university semesters. Their timing and duration were convenient to most of the trainees, who like this research-oriented training on a university campus providing a suitable atmosphere for the transfer of new knowledge. The networking of many institutions of higher education in the region along the way was also a plus according to many core trainees, and some of them found that the number of partner organizations and participants was still too limited.

Weaknesses. In theory, a better chronological order among the instructors and their respective disciplines could have been imagined to avoid too much "jumping" from one view to the next. Under an externally funded project mode of operation, many logistical constraints interfered and limited the possibility to plan a smoother succession of the themes and topics to be covered during the whole training process. But some trainees looked for ways to engage trainers further in the collaborative process.

The management of heterogeneous groups needed improvements as, in the beginning of the training process, few specific activities were available for newcomers who did not plan to build personal applications. During group exercises, techniques like the so-called "snowball" discussions (two trainees analyze a question, then they pool their findings with those of another couple of trainees, and so on, to produce a unified view and answer) were emphasized to help them catch up with the core group.

This short-course model was not very adapted to the construction of a full case study from A to Z to describe the problem, identify the relevant theory and concepts, make methodological choices, and continue with detailed stepwise procedures for model development. Such a process was requested by several core trainees and is being implemented with them under separate specific projects. The short course format did not allow enough time for computer exercises. Following a few courses, several trainees found that more real-world activities were desirable. Role-playing games (a tool frequently associated with MAS models in companion modeling) were inserted in the program of the following sessions, with one with villagers in Khon Kaen Province during the April 2003 course.

Contents

Strengths. The fact that these short courses covered diverse themes and issues in MAS for INRM, from various disciplinary points of view, and were led by instructors who are leaders in their fields were seen as key strengths of this training project. Core trainees also found a suitable balance between theoretical/abstract and applied/practical contents to understand the subject matter and to be able to apply this new knowledge. The construction of a collection of models providing numerous examples and case studies ("I always need an example" said a trainee) was also assessed as an appropriate choice. Core trainees also liked the possibility to combine different tools in the development of their applications. Attempts at bridging the gap between computer scientists and other specialists by using simple tools to stimulate the collective construction of new models were also well received. In particular, the usefulness of the diagrammatic representations (class, activity, and sequential diagrams) of the unified modeling language (UML) for such a purpose was confirmed.

Table 2. Composition of the audience during the short courses of the interdisciplinary training program.

Numbers	KKU Oct 2002	CMU Feb 2002	KKU Mar 2002	CU Apr 2002	CMU Oct 2002[a]	CU Mar 2003	KKU Apr 2003	CMU Oct 2003	CU Mar 2004	CU Apr 2004
No. of core trainees	10	14	14	12	10	7	7	11	10	11
No. of new trainees	12	7	4	7	10	10	11	10	3	3
No. of observers	5	4	1	2	5	0	2	1	1	3

[a]CMU = Chiang Mae University, CU = Chulalongkorn University, KKU = Khon Kaen University.

Table 3. Average scores and standard deviation of the overall course effectiveness for the successive training sessions of the interdisciplinary training program according to the trainees. Rating scale: 1= poor, 5= excellent.

Item	KKU Oct 2002	CMU Feb 2002	KKU Mar 2002	CU Apr 2002	CMU Oct 2002[a]	CU Mar 2003	KKU Apr 2003	CMU Oct 2003	CU Mar 2004	CU Apr 2004
Mean score	4.36	4.50	4.10	4.50	4.67	4.21	4.33	na	4.64	4.50
Standard deviation	1.03	0.50	0.29	0.50	0.47	0.41	0.60	na	0.48	0.63

[a]CMU = Chiang Mae University, CU = Chulalongkorn University, KKU = Khon Kaen University.

Weaknesses. Because there were several weak articulations between the themes of successive courses, the self-updating of the global picture by the trainees themselves was a difficult exercise. In the later courses, more support and time for critical discussions on the contents of the course were provided to help the trainees achieve such a continuous reconstruction by integrating the new knowledge acquired over the last course in the whole picture. But very few trainees managed to perform such a difficult intellectual process by themselves. Efforts were also made to better manage the language barrier by clarifying all key concepts and specific terminologies in lay language. With time, more Asian applications were made available in the second half of the training process to provide an easier understanding of case studies by the participants. At that time, some of the most advanced trainees were also requesting the introduction of other ways to represent and formalize knowledge in MAS in the remaining short courses.

Knowledge transfer: assessment of trainees' cumulative improvements

When asked if they observed cumulative improvements in their knowledge and skills related to these interdisciplinary courses, the core trainees answered "yes," "absolutely yes," "of course," or "yes, very effectively, more or less linear." If some of them found that these improvements are following a linear pattern, others say that a given course (usually the joint courses on watershed management and linking MAS with GIS held at CMU in October 2002) accelerated this process by providing them with a clearer view of several key concepts and a more global perspective of the training process in which they were taking part. They also agreed that such a progress was facilitated by the structure of the training process itself.

The fact that, altogether, 14 applications are currently being developed across five countries (seven in Thailand, two in the Philippines, Vietnam, and Indonesia, and one in Bhutan) to examine concrete INRM issues is also a relevant indicator of the progress made by core trainees. The development of such personal projects seemed to be necessary to guarantee continuity in the effort to improve the trainees' skills in using the approach, methods, and modeling tools introduced to them during the short courses.

Two core trainees have already taken several weeks of complementary training in France on MAS modeling using CORMAS and two more will follow their path in 2005. The MAS approach has also been integrated into the Master of Sciences theses defended by four project trainees from Bangladesh, Bhutan, the Philippines, and Thailand. Seven others from Bangladesh, the Philippines, Thailand, and Vietnam have prepared proposals for doctoral studies in this field and have been accepted at universities in France, Japan, Canada, and Thailand. They are going to invest in this field to deepen the transfer of knowledge and know-how on MAS for INRM as much time is needed to assimilate innovative approaches, methodologies, and tools for sustainable impact.

Several participants have already used MAS and shown their first applications in conference presentations. Other core trainees are already teaching MAS for INRM modules at their respective universities, particularly in Thailand and the Philippines. Trainees are becoming trainers as the contents of these courses are being introduced in graduate study programs at several universities: two short courses and workshops

for M.Sc. students were held in 2002 at the University of the Philippines-Diliman campus, a new course on "Simulation with the MAS Approach" is now being offered at Ubon Ratchathani University in northeast Thailand. This approach is also being presented in the new Post-Graduate Training Program in Systems Agriculture of the Faculty of Agriculture of Khon Kaen University and will be taught in the new Master of Science Program in Agricultural Technology and Natural Resource Management at Chulalongkorn University in Bangkok. Consequently, a significant dissemination of the contents of this training process across national institutions of higher education is already under way.

Management of interdisciplinarity

Interdisciplinary exchanges between instructors and trainees occurred permanently during this training project, but also among trainees. They were sustained by the diverse academic profiles and professional experiences (lecturers, researchers) of the European instructors and the selection of the Asian participants. Figure 4 shows that a high level of interdisciplinarity among trainees has been maintained during the whole training process. But the level of representation of the different disciplines has varied over time. Although many trainees coming from the social and economic sciences participated in the first four courses, their number decreased when the themes of the subsequent courses covered the use of GIS and watershed management; then, a partial recovery in their participation occurred during the last two courses focusing on economics and social psychology. While several agricultural scientists attended almost every course, more trainees coming from ecology and biology joined them at the end of the series of short courses. Figure 4 shows that, so far, the most stable group of participants had an academic background in land-use studies and GIS.

In this project, the interdisciplinary exchanges were guided by the existence of a broad common approach to the use of MAS among the trainers. This approach was explained to the trainees at the beginning of the process, but, with many newcomers joining in the subsequent courses, it was necessary to find ways to recall and re-explain it with more details. Several core trainees among the most experienced ones also requested to discuss explicitly the different points of view and possible conflicts between the contents of presentations made by different instructors.

It remained difficult to establish strong linkages among computer scientists, ecologists, and social scientists for them to work on common applications as interdisciplinary teams in their institutions. But the fact that several computer scientists joined in the last courses is encouraging. It is interesting to observe that it is not among the partner institutions that are well known for their early work on systems thinking in agriculture and resource management that we observe the emergence of interdisciplinary teams in MAS for INRM. The difficulty of establishing collaboration among staff from different faculties could partly explain this rather unexpected situation.

The use of simple modeling tools, such as UML diagrams, proved to be effective in stimulating interdisciplinary exchanges of views when conceiving a new model, and before its implementation and coding in a computer language by a specialist. The "snowball" discussion technique also created greater participation and interactions among trainees having different disciplinary backgrounds to produce ideas and come up with a unified view on the subject matter. The organization of the successive

courses in different settings, taking advantage of the strong expertise of each institution (GIS at CMU, role-playing games at KKU, ecology and social sciences at CU), also helped to sustain interdisciplinary exchanges. We see trainees becoming more and more interdisciplinary-minded, but we have yet to assess changes in their professional practices at their respective institutions. Nevertheless, some participants would like to see a suitable pathway along which trainees could monitor gradual improvements toward mastering interdisciplinary research.

Extended partnerships

The emergence of a regional network of core MAS for INRM practitioners was observed. Its members, linked by a strong bond and common interest (and friendship), are sustaining the effort thanks to regular "get-together" events during the past short courses. If this young network still needs external support at this stage, several core participants are already realizing that external funding is also a weakness of the current process. Fifteen institutions, particularly from Thailand, Vietnam, and the Philippines, are involved in sharing knowledge and experiences in modeling and simulation, but also differences in their respective social and cultural systems and environments. Their network of contacts, especially in Europe through the course instructors' teams, is already extensive. But it could easily be much broader if the trainees were more active exchanging messages on the global CORMAS electronic discussion list.

Beyond the joint publication of a first set of MAS-based applications in the present volume, core trainees said that more people and institutions will become involved in the undertaking in the years to come as they expect to initiate follow-up MAS-based applications projects among former participants in this project and their respective contacts. They also want to see a stronger Asian network of practitioners disseminating MAS-based modeling approaches applied to INRM and social dynamics.

Some trainees think that they will have the capacity to influence scientists and experts in mission-oriented research and interdisciplinary practices, particularly computer scientists. They think that they will be in positions to influence policy design through MAS simulations. They also want to move toward setting up an Asian Club for Social Simulation and organizing a conference on MAS for INRM in Asia to share and discuss experiences among project participants. Such activities could help widen the influence of their young network by inviting other Asian country representatives, such as from Japan, China, etc.

Conclusions: preliminary sustainable outputs and perspectives

On the basis of this series of 11 courses and numerous case studies being developed across the region, these project activities delivered promising collective learning methods and tools to enhance stakeholders' participation in resource management. Participants discovered a new way of thinking and an innovative approach to interpret their environment and real-world phenomena. They said that they were broadening their knowledge and vision. Now, they understand a new research paradigm for INRM, which is more applied, more "useful," and more action-oriented. This "different way to

look at things" is also characterized by an increased awareness of the need to take into account agents' behavior and diversity of viewpoints when designing applications.

We are now witnessing the emergence of a regional network of MAS for INRM practitioners in Southeast Asia who are selecting this field for their masters and doctoral studies. They are also disseminating the message in their respective institutions, developing practical applications on local real-world issues, and are already engaged in the joint publication of their results. They are also discussing ways to structure and reinforce their recent regional network.

Such innovative ways of looking at resource management problems and of thinking about how to alleviate them collectively need to be further introduced in existing graduate study programs at various institutions of higher education to meet the future demand in resource managers at the local level. It is also desirable to study how more young scientists could be exposed to these ideas and methods early in their professional career. In collaboration with Chulalongkorn University, the authors are currently in the process of establishing an international graduate study program in this field in Thailand. It will build on the dynamics created by the training process described in this article and serve the future needs for similar training across Southeast Asia. To avoid some of the weaknesses of the past project, such a new program would have to be more connected to local research support programs and less dependent on external funding. A specific "E-collective learning on companion modeling project" has also been launched recently to build a well-documented site on the Web that will support other types of learning activities such as lectures and training courses, participatory modeling and simulation workshops at different research sites, etc. Beyond training activities, these new projects should have strong research components to continue the adaptation of the companion approach to the Asian context and the development of local case studies examining concrete problems by using state-of-the-art methods and tools in the fast-developing field of MAS for INRM.

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Notes

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Acknowledgments: The authors would like to thank Dr. Rhodora Gonzalez, Nongluck Suphanchaimart, Panomsak Promburom, Warong Naivinit, S.K. Morshed Anwar, and Stanislas Boissau for their valuable contributions during the preparation of this paper.